Patent Application of Derek B. Shuman
for

# TITLE: CONVERTIBLE CLIPLESS BINDING/UNBOUND BICYCLE PEDAL

## CROSS-REFERENCES TO RELATED APPLICATIONS

Not applicable.

## BACKGROUND --FIELD OF INVENTION

This invention relates to foot operated pedals for human powered machinery, more specifically to bicycle pedals, both clipless binding pedals where the shoe is attached to the pedal, and platform or cage type pedals, where the shoe is unattached to the pedal (unbound).

## BACKGROUND--PRIOR ART

Bicycle pedals traditionally have supported the cyclist's feet on a platform which could either be an essentially large flat surface, or the edges of two transverse rails, more commonly known as cages. These pedals are most commonly used in what is called here an unbound mode, operation, or style, where the shoe is not attached to the pedal with any type of binding, clip, or strap. This allows the use of almost any type of shoe to be worn while riding the bicycle and requires a minimum of skill and encumbrance to operate the pedals. Many types of bicycle riding, including some types of racing, are also performed using unbound style pedals, where there is a significant chance the cyclist might fall off the bicycle, and/or where a high degree of handling skill and balance is required. Pedals for this type of riding have evolved to provide large shoe contacting areas and highly efficient sole gripping surfaces. In addition, the shoe contacting surfaces on some pedals are slightly curved to better fit the natural curvature of the front part of the sole, for better security from slipping and for more comfort. In certain types of riding, such as freestyle, or observed trials, the bottom side of the pedal, opposite the cyclist's foot is sometimes used to rest on a stationary object, such as a curb, log, rock, etc.

The platform pedal, especially the cage style pedal, has long been modified to provide an attachment of the cyclist's shoe to the pedal. The most common type of attachment prevalent today is still the toeclip and toestrap. The toeclip is a metal or plastic strip which extends forward from the pedal, under the toes, curving up in front of the toes, and then rearwards over the top of the cyclist's front portion of the foot. A flexible, adjustable loop, called a toestrap, connects the end of this toeclip with the body of the pedal and serves to bind the cyclist's foot to the pedal, a process generally known as "clipping in". This toeclip and toestrap shoe retention system allows the cyclist to pull the pedal rearward through the bottom of the stroke, pull it upward through the rearward part of the pedal stroke, and finally, to push it forward through the top of the stroke, all in addition to the usual downward pushing motion, which is the only propulsive stroke possible without the shoe retention system. This results in more power output and faster speeds. For more secure retention, the rails of the cage style pedal are utilized as part of a cleated shoe retention system for cyclists wearing stiff soled cycling shoes. A transverse grooved block, known as a cleat, is attached to the shoe sole, with the groove engaging the rearward cage rail. When used with a toestrap, this allows a higher force to be transmitted to the pedal through the top and bottom of the pedal stroke, and the groove aligns the shoe to the pedal, to maintain both fore/aft positioning and rotational alignment of the shoe to the

pedal.

More recently, alternate means of attaching the sole of the shoe to the pedal have become popular, the generally termed clipless pedal, so named because of the lack of a toeclip and toestrap. This system comprises a binding on the pedal body that engages a binding plate attached to the shoe sole when the cyclist steps onto the pedal, similar to a step-in ski binding. This process is also generally referred to as "clipping in", and the binding plate is also generally referred to as a "cleat". All subsequent references to these two terms in this application pertain to clipless bindings, unless otherwise noted. After clipping in, the cyclist's foot stays attached to the pedal until a typically sideways twisting motion disengages the cleat from the binding. Several recent types of clipless binding systems for off-road bicycle usage have been designed which feature a small cleat fully recessed into the sole of the cycling shoe which then allows walking without contact of the cleat with the ground. This allows the rubber sole of the shoe to provide better traction on the ground, reducing slippage, and eliminates the marring of floor surfaces by the cleat, which is typically made from metal. These clipless shoe binding systems featuring recessed cleats have become very popular since their introduction around 1990, and though originally developed for off-road bicycle usage, they have also become popular for road cycling as well, as all cyclists wearing cleated cycling shoes must walk in them, even if only to get on and off the bicycle.

Advantages of the newer clipless binding systems, especially those with shoe recessed cleats, include the ability to have bindings on both sides of the pedal, unlike the older cage and toeclip system. This makes it easier for the cyclist to clip in to the bindings. The cyclist does not have to spin the pedal around to find the correct side. Other types of clipless pedals having only a single binding are counterweighted so that the correct side comes up automatically, however bearing friction, grease viscosity, and seal friction, all of which can be dependent on temperature, wear, adjustment, and the presence of dirt or water, tend to make this method of pedal alignment unreliable. If the pedal spins freely enough to assure that the counterweight reliably rotates the pedal, the cyclist often "overspins" the pedal inadvertently.

Both the traditional toeclip type pedal and all of the new clipless binding type pedals do not allow safe and comfortable unbound mode usage on both sides of the pedal while wearing a shoe with a cleat designed to engage the clipless binding(s). Nagano, U.S. Patent #5,003,841 (1991) shows a pedal with both shoe supporting surfaces (cages), and clipless bindings on both sides of the pedal. The binding cleats for use with this pedal are large and protrude substantially downward from the shoe sole, having the disadvantage of not being recessed into the sole of the shoe sufficiently to allow comfortable and safe walking or cycling in unbound mode. This pedal does, however, allow the bindings to be sufficiently recessed into the pedal, such that a shoe having a largely smooth or lightly treaded sole, and not having a cleat attached, may be used comfortably and safely in unbound mode.

The clipless pedals designed for shoe recessed cleats and having bindings on both sides of the pedal typically feature small shoe contacting areas that are slippery and not level or smooth. They are uncomfortable and unsafe to ride without wearing a stiff soled cycling shoe with a cleat that is clipped in to the binding. The toeclip pedal has only one toeclip on one side of the pedal, and thus the other side of the pedal can be ridden unbound style, however when this is done, the toeclip and toestrap hang underneath the pedal, close to the ground, and can be unsafe and prone to damage if the toeclip or toestrap snags or drags on the ground.

All of the clipless binding pedals, as well as the older toeclip style pedal have the inherent disadvantage of being difficult to mount and ride in many cycling situations. Clipping into these pedals requires concentration and accurate foot placement. On smooth roads at low uphill, level, or downhill grades, the cyclist can coast momentarily after an initial start and generally has enough time to perform this operation even though it is inconvenient and distracting. However, for medium to

high uphill grades, or on difficult off road terrain, the cyclist must begin pedaling immediately after mounting the pedals. The cyclist typically clips into a pedal before mounting the bicycle, but then does not have time or balance to clip into the second pedal, or, if using a pedal with a single binding, to determine which side of the pedal is up, and to spin the pedal if necessary. Often the cyclist must fully come to a stop, straddle the bicycle and try to get clipped in from a standstill. This can be difficult even for an experienced racing cyclist and can result in time loss during a race. For a cyclist riding on busy streets, the distraction of trying to clip into the pedal can be dangerous by diverting the cyclist's attention to traffic, especially at intersections, where many hazards exist.

In many of the conditions where clipping into the pedals is difficult, riding while clipped in is also difficult and unsafe as well. This can include riding over rough terrain where agile body motions, including lifting a foot off a pedal, are required to keep balanced over the bicycle, or when riding in busy traffic, where the cyclist may feel the need to stop suddenly, to jump off the bicycle, or lift it suddenly onto a curb, in response to an impending hazard. The ability to perform agile body motions without the feet being attached to the pedals is the main reason why cyclists performing the sport of observed trials cycling (a form of obstacle course riding over difficult terrain), BMX (bicycle motocross racing) or freestyle (stunt riding at low speed on ramps and found urban objects) bicycle riding typically use unbound style pedals. This is true even though clipless binding pedals might appear to give the cyclist an advantage in hopping the bicycle over obstacles, as is often done in these sports. When encountering difficult terrain, the cyclist using clipless pedals cannot easily lift a foot off the pedal to maintain balance, and thus must often dismount the bicycle to walk it through, whereas they might be able to ride through it if they had unbound style pedals installed. Few cyclists, if any, carry an extra set of pedals and a wrench to change them, when they ride, as these items are heavy, and it is difficult and time consuming to perform this operation.

One manufacturer, Shimano, makes a pedal, model number M-323, which has a clipless binding on one side and a cage on the other side, the cage intended for unbound use only, and not for use with a toeclip and toestrap. This pedal has the advantage that the cyclist may comfortably ride the bicycle regardless of the type of shoe being worn. In addition, the cyclist wearing a shoe with a recessed cleat designed to engage the clipless binding, may ride in either unbound mode or clipped in mode. However, when mounting the pedal, either on the clipless binding side, or on the cage side, the cyclist must still look and/or feel for the side desired, and then spin the pedal one half turn, if necessary, to turn the desired side up. As with the aforementioned toeclip type and single sided clipless binding type pedals, this operation requires practice and concentration to perform smoothly and proficiently, and thus this pedal suffers many of the aforementioned disadvantages of both toeclip type and clipless binding type pedals. In most of the aforementioned situations where clipless and toeclip type pedals are difficult to mount and clip into, the operation of looking and/or feeling for which side is up, then spinning the pedal one half turn to place the cage side up is only marginally less difficult, due to the high probability of overspinning the pedal under the time pressure of mounting the bike and quickly clipping in. In addition, when riding in either mode, the cyclist must perform this operation every time he/she takes their foot off the pedal, as the pedal may spin to place the opposite, undesired side upwards. This problem is most pronounced when riding in unbound style, as the foot comes off the pedal easier, and more frequently. As such this pedal is at a disadvantage compared to conventional unbound type pedals for riding in difficult terrain or in conditions where the cyclist desires to ride in unbound mode while maintaining the ability to lift the foot off the pedal freely.

Nagano, U.S. Patent #5,806,379 (1998) shows a bicycle pedal system having both clipless bindings and unbound type tread surfaces. The preferred embodiment is essentially a clipless binding pedal supplied with separate platform type tread surfaces that attach to the binding using an integrally formed cleat on the underside of the platform surface. This is an obvious solution for

providing dual mode clipless or unbound capability on either one or both sides of the pedal. It is difficult to install and remove because the typical cleat engagement force of the binding is necessarily high, to prevent inadvertent cleat release from sideways foot pressure under the full weight of the rider. The tread surfaces must be installed by hand and thus great hand pressure is required to install and remove them, typically beyond the capability of most riders. A lever tool, such as a screwdriver must often be used to remove these platforms from the bindings. An alternative embodiment shows an unbound type pedal, similar to a platform or cage style pedal, that allows the attachment of clipless binding mechanisms, using screw fasteners. This alternative is also difficult to use, by the obvious requirement to separately carry a screwdriver. Both embodiments require the user to separately carry the platform surface or clipless binding attachments plus any tools needed to install them, a clear drawback. Both embodiments also require the user to stop riding in order to attach or detach the platform surface attachments, another clear drawback.

Chen, U.S. Patent #5,916,332 (1999) shows a cage type pedal having a detachable clipless binding for a recessed type cleat mounted on one side of the pedal. This pedal has the advantage of being convertible to unbound mode on both sides of the pedal by removing the clipless binding, which is attached to the pedal with a screw. This pedal, however, has the same disadvantages of the pedal system of Nagano, U.S. Patent #5,806,379 by requiring the rider to stop and dismount the bicycle in order change pedal operation modes, and by requiring the rider to carry either a screwdriver or hex wrench, and to carry the separate clipless binding when operating in unbound mode on both sides of the pedal.

What is needed is a clipless pedal for a recessed type cleat, that can be set or configured to operate as either a unbound pedal on both sides of the pedal, or as a clipless pedal on both sides of the pedal, so that the cyclist does not have to carry separate platform attachments, bindings, screwdrivers, hex wrenches, or other tools in order to change operation modes. Such a pedal would not require the cyclist to determine which side is up when mounting the pedals, and would allow him/her to simply step on the pedals (clipping in to the binding, if using clipless binding mode), and commence pedaling immediately. Furthermore, the mode of operation should be easily and quickly changeable without the need for the cyclist to stop, or even to look down at the pedals while coasting. Another benefit would be that the same set of pedals providing recessed cleat clipless operation would also allow comfortable cycling with any kind of shoe suitable for unbound operation, without the necessity of spinning the pedal to select the desired mode of pedal use. Such a convertible, truly dual mode pedal would eliminate the need to have more than one set of pedals, frequently installing and removing them from the crank arms, a process that eventually damages the pedal threads on the crankarm, or to carry separate platform surfaces or bindings.

There are some recent pedal designs which attempt to provide both unbound and clipless operation on both sides of the pedal, with only limited success. Hanamura, U.S. Patent #5,771,757 (1998) shows a pedal which incorporates clipless bindings on both sides of a pedal body having a large shoe contacting area, with similarities to a cage style pedal, surrounding both clipless bindings. The clipless bindings, however, protrude above the shoe contacting area of the cage at all times. This protrusion of the binding above the shoe supporting surface is necessary to properly engage the shoe cleat that is recessed into the shoe sole. This pedal is designed primarily for off-road downhill use, where the cyclist is usually clipped in, but becomes unexpectedly unclipped and cannot immediately clip back in due to travel at high speeds on rough terrain. Under these circumstances it is helpful to have cages surrounding the bindings to assist the cyclist in locating the pedal, providing a temporary place for the shoe to rest until the cyclist can get clipped back in. Limited propulsive pedaling may be possible without clipping back in, but the clipless binding which protrudes above the shoe supporting surface is slippery against the cleat when not properly engaged. The rider is forced to place his/her foot substantially askew in order to gain a secure foot placement. In addition, the

bindings protruding above the shoe supporting surfaces are also slippery and uncomfortable against non cycling shoes without a cleat. Most non-cycling shoes have a relatively compliant sole and the foot feels a concentrated pressure under the small clipless binding. Thus, this pedal does not allow comfortable, safe, or efficient pedaling with any shoe which is not clipped in to the binding; as such, it is not suitable for unbound style riding, except under the temporary and specific conditions it was designed for.

Ueda, U.S. Patent # 5,784,931 (1998) shows a clipless bicycle pedal designed to engage a recessed cleat, having a spring loaded, rotatable tread cage surrounding the clipless binding. This design is a variation of the previous design of Hanamura, U.S. Patent #5,771,757, in attempting to provide contact between the tread cage and the shoe sole while the cleat is engaged with the binding mechanism. It is described, though not claimed, as providing a shoe resting surface for a cycling shoe when the cleat cannot be engaged, as encountered during many types of off-road bicycle racing. However, the cage is only designed to rotate about the pedal axis to move out of the way to allow cleat engagement. It's height relative to the binding does not change. No figure shows a shoe sole being supported by the cage alone. Under any significant foot pressure, the cage will rotate relative to the binding until the shoe is supported either on top of, or engaged with the binding. Only a cleat engaged position will be stable, as metal to metal contact between the bottom of the cleat and the top of the binding is very slippery and insecure. As such, the cage is not truly supportive of the rider's foot and cannot provide a stable shoe supporting surface for any type of shoe. As such this pedal cannot be considered a dual mode unbound/clipless pedal; it is a clipless pedal that attempts to provide a temporary surface for the rider to place their foot when terrain and/or speed prevent them from immediately clipping in to the binding. Thus this pedal design is not effective for use in unbound mode, and, like the design of Nagano, U.S. Patent #5,771,757 described above, is intended only to aid the rider in achieving cleat engagement under difficult circumstances. As such, it does not anticipate a bicycle pedal according to this invention, as it does not provide sufficient height variability between a binding and a shoe supporting surface to be comfortably and safely usable in either clipless or unbound mode.

Other pedal designs show height variability between a clipless binding and the pedal body, though not for the purpose of providing both unbound and clipless modes on a single pedal. Ueda, U.S. Patent #6,012,356 (2000) shows a clipless bicycle pedal designed for a flush or recessed shoe cleat having a small amount of height variability between the binding and the pedal body, for the purpose of achieving a slight amount of contact between the portion of the shoe sole laterally surrounding the cleat and the pedal body. This lateral shoe sole contact is claimed to reduce side to side rocking of the shoe when engaged with the cleat. This pedal is designed for clipless operation only, and the pedal body is formed to directly support the shoe sole only at two small areas over the pedal spindle; it does not provide unbound style support over a large shoe sole area. The small amount of height variability acts only on part of the binding and would not be sufficient to fully retract the binding into an platform or cage style pedal body to allow it to be used in an unbound mode.

A desirable modification to the aforementioned desired dual mode clipless/unbound pedal having a choice of either clipless or unbound operation on both pedal sides, which would be useful for riding in steep or difficult terrain, or for riding in busy traffic, would be for the cyclist to be able to preset the pedal to automatically transform to an unbound type pedal on both sides of the pedal, immediately upon the release of the cleat from the binding. This would allow a cyclist wearing cycling shoes with recessed clipless binding cleats to deliberately unclip from the pedal and continue pedaling, uninterrupted, in unbound mode over sections of difficult terrain, or in busy traffic for instance, without having to first unclip, and then reach down to convert the pedal to unbound mode. The conversion operation could be difficult or impossible to perform while coasting the bicycle in

these conditions, requiring the rider to stop to make the conversion. This automatic conversion feature thus allows a cyclist to remain riding clipped in, as long as possible, as it eliminates the necessity of predetermining or guessing where the terrain or riding conditions become too difficult to continue riding while being clipped in. Thus, a cyclist could ride while staying clipped in into more difficult terrain than otherwise possible, as the rider would not have to stop to switch the pedals to unbound mode. This would be a decided advantage in off road competitive riding on difficult terrain.

Another useful pedal design for certain types of riding such as observed trials or freestyle, would be a pedal which features a fixed height shoe supporting surface on one side, in combination with a clipless binding and shoe supporting surface on the other side, where the relative height between the binding and shoe supporting surface (on the same side) are sufficiently variable to allow the pedal to be used as an unbound style pedal on both sides, or as an unbound pedal on one side, and a clipless pedal on the other side. This would allow the cyclist to use the downward facing surface to momentarily rest or balance on a log, rock, curb, or other suitable object, as is done in above mentioned sports, while remaining clipped in. The downward facing shoe supporting surface would provide better grip on objects, and be less susceptible to damage than an exposed binding facing downwards. A desirable modification of this design would be to additionally be able to set the pedal to automatically transform to an unbound type pedal on both sides of the pedal, immediately upon the release of the cleat from the binding, as described in the preceding paragraph. Thus, the cyclist can ensure that a shoe supporting surface always faces downward, even after unclipping from the pedal.

## SUMMARY

Accordingly, a bicycle pedal according to this invention provides:

A bicycle pedal having both clipless shoe retention mechanisms (bindings) and full load bearing shoe supporting surfaces on each opposing side of the pedal, wherein the relative height between the clipless binding and the shoe supporting surface of each side of the pedal is sufficiently variable, such that the cyclist's shoe either rests and is supported fully on either of the shoe supporting surfaces to provide unbound operation, without the riders shoe being attached to the pedal, or engages either of the bindings to provide clipless binding operation, as desired. The setting of the relative height between the bindings and shoe supporting surfaces is effected on both sides of the pedal, simultaneously, upon a single actuation performed by the cyclist. The setting of the relative height between the bindings and shoe supporting surfaces can be quickly and easily accomplished by the cyclist, without looking down, even while riding (coasting). The cyclist may also set the pedal, while engaged to the binding, to automatically change to unbound mode, on both sides of the pedal simultaneously, immediately upon the release of the shoe cleat from the binding. In a further embodiment, only one side of the pedal features a clipless binding and a shoe supporting surface which are relatively variable in height; the other side of the pedal features a fixed shoe supporting surface only. The aforementioned feature providing automatic change to unbound mode upon shoe release may be combined with this embodiment.

## OBJECTS AND ADVANTAGES

Several objects and advantages of the present invention are:

(a) Cyclists retain all the existing advantages of dual sided unbound type pedals, more specifically: cyclists wearing either cycling shoes with recessed clipless cleats, or other suitable shoes not specifically designed for cycling, such as normal street or athletic shoes, can safely and comfortably mount the pedals and ride in an unbound mode without first having to check which side of the pedal is up, and without having to spin the pedal one half turn, if required. This results in less distraction of the cyclist from cycling, allowing safer cycling in difficult terrain or busy environments. The rider is able to pedal over more difficult terrain than is possible when using clipless bindings. This can produce a competitive advantage in many types of off-road bicycle racing, and greatly eases the resumption of uphill cycling from a stop, either on or off-road. The cyclist need not stop to attach separate shoe supporting surfaces to the bindings, or to change pedals in order to have this capability.

(b) The cyclist additionally retains all the existing advantages of dual sided clipless pedals, more specifically: the cyclist, if wearing shoes with clipless cleats, can also mount the bicycle and clip in to bindings on either side of the pedal, without the need to check which side of the pedal is up, and to spin the pedal one half turn, if required, to place a binding upward. The cyclist need not stop to attach separate bindings to an unbound type pedal, such as a platform or cage style pedal, or to remove such pedals from the crankarms, and then install clipless pedals to have this capability.

(c) The cyclist can switch the mode of pedal operation from unbound mode to clipless binding mode or vice versa, quickly and easily, even while riding, without looking down at the pedal. The mode of operation changes on both sides of the pedal simultaneously, upon a single actuation from the cyclist.

(d) By providing an optional setting to provide automatic conversion to unbound mode upon cleat release, the cyclist can ride, if desired, with increased confidence, while clipped in to the binding, through most riding situations which would otherwise be safer to ride through in unbound mode, as the cyclist can immediately change the pedal to unbound mode, by simply releasing [his/her shoes] from the binding. This allows the cyclist to output more energy over rough or difficult terrain, which can provide a competitive advantage in many types of off-road bicycle racing. It can save the cyclist from having to dismount and walk the bicycle through difficult terrain, as this is often the only option for cyclists who ride clipless pedals that do not have a platform or cage type unbound shoe supporting surface on one side of the pedal.

(e) In an optional embodiment providing a fixed shoe supporting surface only on one side of the pedal, and having the aforementioned relative height variability between a clipless binding and a shoe supporting surface on the other side, and in addition, having the automatic conversion feature described in paragraph (d) above, a cyclist may ride through rough terrain while clipped in, and may use the bottom shoe supporting surface facing downward to securely rest momentarily on obstacles such as logs, rocks, or other suitable objects, while maintaining the advantage of having the pedal immediately convert to unbound mode on the top side of the pedal, should the cyclist need to unclip for safety or balance reasons, in situations where the cyclist cannot easily clip back into the pedal. This embodiment can be operated without utilizing the automatic conversion feature of paragraph (d) above, and the cyclist still has the advantage of a pedal which can function in both clipless and unbound modes, as previous designs allowed, yet retains the additional capability of operating the same pedal in unbound mode on both sides simultaneously, without requiring the cyclist to look or

feel for which side of the pedal is up, and to spin it one half turn, if necessary, when operating in this mode, or to stop and attach separate shoe supporting surfaces. This is advantageous for cyclists who desire to ride in unbound style only in certain conditions, such as rough ground, or busy traffic, that make spinning the pedal one half turn difficult and/or unsafe. Some cyclists may not care to have clipless binding capability on both sides of the pedal, as they would choose this mode of operation only under conditions where there is ample time to spin the pedal to place the binding side of the pedal upward. These riders would still prefer to have the unbound mode available on both sides of the pedal, of course. Such a pedal will be lighter and less expensive due to the elimination of one of the bindings.

## LIST OF FIGURES- PREFERRED EMBODIMENT

Figure 1A is an oblique view of the preferred embodiment of a bicycle pedal according to this invention showing bindings extended outward from the pedal body for use as a clipless binding pedal.

Figure 1B is an oblique view of the preferred embodiment of a bicycle pedal according to this invention showing bindings retracted into the pedal body, for use as an unbound style pedal.

Figure 2 is an oblique view of the preferred embodiment of a bicycle pedal according to this invention, with a partial section and cutaway showing internal details, with clipless bindings extended.

Figure 3A is a sectional side view of the preferred embodiment of a bicycle pedal according to this invention, as indicated by section lines 3A-3A on figures 1A and 2, with the clipless bindings extended.

Figure 3B is a sectional side view of the preferred embodiment of a bicycle pedal according to this invention, as indicated by section lines 3B-3B in figure 1B, with the clipless bindings retracted.

Figure 3C is a sectional side view of the preferred embodiment of a bicycle pedal according to this invention, as indicated by section lines 3A-3A in figure 1B and figure 2, but with the clipless bindings engaged

Figure 3D is a side view of the preferred embodiment of a bicycle pedal according to this invention, with bindings extended outward from pedal body, as viewed in the same direction as section lines 3A-3A, in figures 1A and 2.

Figure 4A is a sectional side view of the preferred embodiment of a bicycle pedal according to this invention, as indicated by section lines 4A-4A in figures 1A and 2.

Figure 4B is a sectional side view of the preferred embodiment of a bicycle pedal according to this invention, as indicated by section lines 4B-4B in figure 1B.

Figure 5A is a sectional top view of the preferred embodiment of a bicycle pedal according to this invention, as indicated by section lines 5-5A in figures 3A, 3D, and 4A.

Figure 5B is a sectional top view of the preferred embodiment of a bicycle pedal according to this invention, as indicated by section lines 5-5B in figures 3A, 3D, and 4A.

Figure 5C is a sectional top view of the preferred embodiment of a bicycle pedal according to this invention, as indicated by section lines 5C-5C in figure 4B.

Figure 6A is a sectional top view of the preferred embodiment of a bicycle pedal according to this invention, as indicated by section lines 6A-6A in figure 3C, showing the bindings in a pre-retracted mode of operation.

Figure 6B is a sectional top view of the preferred embodiment of a bicycle pedal according to this invention, as indicated by section lines 5-5B in figures 3A, 3D, and 4A, showing the bindings being fully released for retraction, but prior to actual retraction.

Figure 7 is a sectional end view of the preferred embodiment of a bicycle pedal according to this invention, as indicated by section lines 7-7 in figures 1A, 2, 5A, and 5B.

Figure 8 is sectional side view of an alternative embodiment of a bicycle pedal according to this invention, as indicated by section lines 3A-3A on figure 1A, closely related to the preferred embodiment, but featuring a single variable height binding on one side of the pedal only.

Figure 9 is a side view, with a partial section as indicated in figure 10, of a prior art shoe and cleat system.

Figure 10 is a bottom view, as indicated by view arrows in figure 9, of a prior art shoe and cleat system.

## LIST OF FIGURES -ALTERNATE EMBODIMENT

Figure 11A is an oblique view of an alternative embodiment of a bicycle pedal according to this invention showing shoe-supporting surfaces in a retracted position, for operation in clipless binding mode.

Figure 11B is an oblique view of an alternative embodiment of a bicycle pedal according to this invention showing shoe-supporting surfaces in an extended position, for operation in unbound mode.

Figure 12A is a side view of an alternative embodiment of a bicycle pedal according to this invention showing shoe-supporting surfaces in a retracted position, for operation in clipless binding mode.

Figure 12B is a side view of an alternative embodiment of a bicycle pedal according to this invention showing shoe-supporting surfaces in an extended position, for operation in unbound mode.

Figure 12C is a side view of an alternative embodiment of a bicycle pedal according to this invention with shoe-supporting surfaces in an extended position, showing a method for retracting shoe supporting surfaces for conversion to operation in clipless binding mode.

Figure 12D is a sectional side view of an alternative embodiment of a bicycle pedal according to this invention showing internal details of a cleat engaging binding, for operation in clipless binding mode.

Figure 13A is an top view, with partial sections showing internal details of an alternative embodiment of a bicycle pedal according to this invention with shoe-supporting surfaces in a retracted position, for operation in clipless binding mode.

Figure 13B is an top view, with partial sections showing internal details of an alternative embodiment of a bicycle pedal according to this invention with shoe-supporting surfaces in an extended position, for operation in unbound mode.

Figure 14 is an end view, with a half section showing internal details of an alternative embodiment of a bicycle pedal according to this invention.

## LIST OF REFERENCE NUMERALS
## PREFERED EMBODIMENT

| | | |
|---|---|---|
| 11 threads | 12 spindle | 13 wrench flat |
| 14 pedal body | 15 shoe supporting surface | 16 sealed roller bearing |
| 18 ball bearing assembly | 19 roller bearing journal | 20A, 20B outer ball race |
| 21 ball | 22 groove | 23 shaft seal |
| 24 retainer cap | 25 screwdriver slot | 27 shoe |
| 28 sole | 29 recessed sole portion | 30 cutout |
| 31 cleat | 32 binding | 33F, 33R tab |
| 34 base | 35 bail | 36 cutout |
| 37 hole | 38F, 38R pin | 39 push tab |
| 40 lock spring | 41 lock tab | 42 link |
| 43 linkage | 44 axle | 45 retraction spring |
| 46 clip | 47 protrusion | 48 pin |
| 48B bore | 49 protrusion | 50 clip |
| 51 bevel | 52 clip spring | 53 tab |
| 54 spring lever | 55 end | 56 hinge loop |
| 57 end | 58A, 58B release plate | 59 cleat engagement notch |
| 60 hinge loop | 61A, 61B bail spring | 62 pin |
| 63 block | 64A, 64B hinge loops | 65 screw |
| 67 cleat engagement guide | 66 pin | 68 pushrod |
| 69 cleat ejector ramp | 70 conical end | 71 bore |
| 72 pocket | 73 mounting hole | 74 stop button |
| 76 central tube | 78 central bore | 80 stop ledge |
| 81 upper ledge | 82 lower ledge | 83, 84', 84" aperture |
| 86 rib | 87 pin boss | 88F front cleat tip |
| 88R rear cleat tip | 89 aperture | 91 rivet |
| 92 flush rivet | 94 end rib | 95L, 95R clip pocket |
| 96 assembly hole | 97 conical depression | 98 thumb or forefinger |
| 99 opposing finger (to 98) | | |

## LIST OF REFERENCE NUMERALS ALTERNATE EMBODIMENT

110 linkage
111 threads
112 spindle
113 wrench flat
114 pedal body
115 shoe supporting surface
115F, 115R front, rear shoe supporting surface section
116 sealed roller bearing
117L, 117R left, right side arm
118 ball bearing assembly
119 roller bearing journal
120A, 120B outer ball race
121 ball
122 groove
124 retainer cap
125 hex wrench socket
130 slot recess
132 binding
134 base
135 bail
136L, 136R left, right bail pivot tab
137' bail pivot pin bore
137" bail pivot pin bore
138 bail pivot pin
139L, 139R left, right bail spring
140 bail spring block
141 adjustment screw
142 front rail
143 rear rail
144L, 144R left, right front rail connector plate
145L, 145R left, right front rail cage pivot bore
146L, 146R left, right rear rail connector plate
147L, 147R left, right rear rail cage pivot bore
148 front rail cage assembly
149 rear rail cage assembly
150 pivot journal
152 pivot tube
154 pivot journal
156 rail extension spring
157A, 157B spring end
158 limit pin
159 limit pin bore
160 limit slot
160' semicircular end
160'' semicircular end
162 limit slot
162' semicircular end
162'' semicircular end
164 spring end slot
165 spring end bore
166 spring end bore
167L, 167R left, right extension lock pin bore
168L, 168R left, right extension lock pin
169 shoulder
170 spring
172L, 172R left, right extension lock pin housing
174 housing lock pin bore
175L, 175R left, right semicircular surface
176 retraction lock pin housing
177 retraction lock pin bore
178 retraction lock pin bore
179 rail mount tab
181 threaded hole
182 retraction lock pin
183 shoulder
184 spring
185 threaded hole
186 central bore
187 rail screw
188 housing screw
190 cleat engagement guide
191 cleat ejector ramp
192 cleat engagement notch
195 screw

## DESCRIPTION OF INVENTION

A preferred embodiment of the convertible pedal is shown in figures 1 through 7. A pedal for the left side of the bicycle is shown in all figures. Figure 2 provides a general view of most parts and features. A pedal spindle **12**, preferably formed of high strength steel or titanium alloy, features threads **11** for attachment to a bicycle crank arm (not shown), and wrench flats **13** for tightening to crank arm. Pedal body **14** is preferably formed of extruded or cast aluminum alloy, or other lightweight metal or high strength plastic. All subsequently described parts, unless otherwise noted, are preferably formed of high strength metal such as alloy steel or titanium. Figure 3D shows the full extrusion cross section profile with hidden lines. Pedal body **14** features top and bottom shoe supporting surfaces **15**, optionally textured as shown here, to provide good shoe sole **28** traction (fig. 4B). Top and bottom shoe supporting surfaces **15** are formed integral with central tube **76**, ribs **86**, and end ribs **94**; these features creating apertures **83**, **84'**, **84"**, and **89**. Ribs **86** feature pin bosses **87**, and central tube **76** features central bore **78** (figs. 5A, 7), machined with threads and multiple steps (not labeled). Central cutout **30**, and pocket **72** are formed, such as by machining, into each section of extrusion forming pedal body **14** to provide operating space and protection for bindings **32**, and most of the subsequently described parts of this invention. Cutout **30** is a generally rectangular shaped opening as viewed from the top in figs. 5A-5D, 6A, and 6B. Clip pockets **95L** and **95R** are rectangularly shaped extensions of cutout **30**. Pedal body **14** also features stop ledges **80**, and upper and lower ledges **81** and **82**, respectively.

Spindle **12** is rotatably connected to central bore **78** by sealed roller bearing **16**, and ball bearing assembly **18** (figs. 5A, 7). Roller bearing **16** rides on journal **19**. Ball bearing assembly **18** comprises two angular contact outer ball races **20A** and **20B**, and balls **21**, which ride in groove **22** in pedal spindle **12**. Retainer cap **24** threads into central bore **78** of pedal body **14** to tighten against and fixedly retain outer ball races **20A** and **20B**. Spindle seal **23**, formed of elastomer, is fixedly mounted in pedal body **14** and rotatably seals against spindle **12**. Sealed roller bearing **16** features integral shaft seals (not labeled) on both sides of the cylindrical rolling elements. Each binding **32** is an assembly and moves as a unit, and consists of base **34**, bail **35**, pins **38F** and **38R**, springs **61L** and **61R**, block **63**, screw **65**, and lock spring **40**. Each base **34** features pairs of tabs **33F** and **33R**. Each pair of tabs **33F** and **33R** fixedly support pins **38F** and **38R**, respectively. Axle **38R** rotatably supports bail **35**. Each bail **35** is urged forwards against the rear of base **34** by bail springs **61L** and **61R**. Urging force of each pair of bail springs **61L** and **61R** is adjustable by screw **65**, threaded into block **63**, and bearing against conical depression **97** of base **34** (fig. 3A). Each bail **35** features cutout **36**. Both base **34** and bail **35** feature cleat engaging notches **59**. Base **34** features cleat engagement guides **67**, and cleat ejector ramps **69**. Base **34** features hole **37** through which push tab **39** of lock spring **40** protrudes. Lock spring **40** is fixedly mounted to base **34** with rivets **92**, whose heads are flush with the top surface of base **34**. Lock tabs **41** are formed on the transverse ends of lock spring **40**. Pins **38F** and **38R** are fixedly mounted in, and protrude laterally outward from tabs **33F** and **33R** respectively, of each base **34**, each protruding end being rotatably supported by link **42**. Both axles **44** are fixedly supported on each end in pin bosses **87** of pedal body **14**. Retraction springs **45** are mounted on axles **44**, with one end bearing against link **42**, and the other end bearing against central tube **76**. Bail springs **61R** prevent excessive axial movement of retraction spring **45**, as can be seen in figures **3A** and **3B**, keeping retraction spring **45** ends engaged with link **42** and central tube **76**. Two clips **46** are rotatably supported in pedal body **14** by pins **48**, which are fixedly mounted in bores **48B** of pedal body **14** (figs 1A,1B). Similarly, two clips **50** are rotatably supported on pins **48**,

also fixedly supported in bores **48B** of pedal body **14**. Clips **46** and **50** are axially restrained on pins **48** by ledges **81** and **82**. Clips **46** and **50** each feature protrusions **47** and **49**, bevel **51**, and tab **53**. Clip **46** features end **55** and clip **50** features end **57**. Springs **52** are fixedly mounted to clips **46** and **50** by rivets **91**. Spring levers **54** are fixedly mounted to clips **46** by rivets **91**, and feature hinge loops **56** on their ends. Release plates **58A** and **58B** feature hinge loops **60** on their ends which are rotatably connected to hinge loops **56** with pins **62**. Pins **62** are fixedly mounted in hinge loops **60**, and rotatably mounted in hinge loops **56**. Both release plates **58A** and **58B** feature coaxial hinge loops **64A** and **64B** which are rotatably connected together with pin **66**. Pin **66** is fixedly mounted in hinge loops **64A** and **64B** of release plate **58A** and rotatably mounted in hinge loops **64A** and **64B** of release plate **58B**. Pushrod **68** is slidably supported in bore **71** (figs 6A,6B) of pedal body **14**, and features a conical end **70**. Stop buttons **74** are fixedly mounted in mounting holes **73** in pedal body **14**.

Assembly of the preferred embodiment is accomplished by first assembling each clip **46**, to its associated spring **52**, spring lever **54**, and release plate **58A** or **58B** together with pins **60** and rivets **91**. Each of these subassemblies is then inserted into cutout **30**, feeding release plates **58A** or **58B** through apertures **89** formed by shoe supporting surfaces **15**, pin bosses **87**, ribs **86** and end ribs **94**. Clips **46** are then placed in clip pockets **95L** and affixed to pedal body **14** by pressing pin **48** into its respective bore **48B**. Clips **50** are assembled to their respective springs **52** with rivets **91** and assembled to pedal body **14** with pins **48** in a similar manner. Next, bindings **32** are assembled to links **42** on pins **38F** and **38R** and inserted into cutout **30** while holding clips **46** and **50** apart, as in fig 6B. Links **42** are then affixed by insertion of axles **44** through pin bosses **87**. Springs **45** are placed on axles **44** during the insertion of axles **44**. Roller bearing **16** and ball race **20A** are then assembled to central bore **78**. Spindle **12** is then assembled to pedal body **14** by inserting it through roller bearing **16**, and inner ball race **20A**, far enough past its normal assembled position in order to fully expose groove **22**. Journal **19** is made sufficiently long enough to avoid interference of the adjacent conical section of spindle **12** with the shaft seal of roller bearing **16** during this operation. Balls **21** are then assembled to groove **22** with grease, then the spindle is withdrawn to seat the balls into race **20A**. Race **20B** is then assembled and secured with threaded retainer cap **24**. Release plates **58A** and **58B** are then assembled together by inserting pin **66** through assembly hole **96** (fig 5A), and pressing it into hinge loops **64A** and **64B**.

In operation of the preferred embodiment, pedal body **14** provides textured shoe supporting surfaces **15** on both the upper and lower sides of the pedal for gripping and supporting, under full rider's weight, the sole **28** of either a non-cycling shoe, or a cycling shoe **27** with a cleat, **31** mounted on a recessed sole portion **29** (figs 9,10). Shoe supporting surfaces **15** may be textured, an example of which is shown, or otherwise configured to provide a shoe gripping surface without cleat attachment. Needle roller bearings **16** with integral seals are used to provide high radial load capability on a relatively large shaft diameter section, and pedal spindle **12**, may be appropriately hardened at journal **19**, for use as the inner bearing race. Ball bearing assembly **18** carries both radial and axial loads and serves to rotatably affix pedal body **14** to spindle **12**. Groove **22** may also be appropriately hardened.

Central cutout **30** encompasses bindings **32** and links **42** when they are retracted into pedal body **14**. The cleat engagement features of the bindings shown here are similar to existing bindings, and do not constitute the essence of this invention. They are described here for clarity, and to show compatibility with the invention. They are representative of a family of clipless bindings which can be used; these mechanisms typically engaging a small cleat attached to the shoe and typically, but not always, recessed into the shoe sole. Cleat **31** is mounted to a recessed sole portion **29**, of sole **28**, of shoe **27**. Cleat **31** has a front tip **88F**, and a rear tip **88R**, both of which are beveled on their bottom

surfaces, flat on their top surfaces, and which engage notches **59F** and **59R**, respectively (fig.3C). Engagement is typically performed by inserting tip **88F** into notch **59F** first, then stepping downward into binding **32** so that the beveled bottom surface of tip **88R** moves bail **35** rearward against the action of bail springs **61L** and **61R**. Cleat engagement guides **67** help direct front cleat tip **88F** into cleat engaging notch **59F**, and the flat upper surface of front cleat tip **88F** is restrained from upward movement by the bottom surface of notch **59F**. Once the extreme end of cleat tip **88R** passes notch **59R**, bail **35** moves forward and retains cleat **31** in notch **59R** by contact with the flat upper surface of rear cleat tip **88R**. The bottom surface of cleat **31** is now resting on the top surface of base **34**, as shown in figure 3C. To release cleat **31**, the rider twists their foot sideways, rotating cleat **31** in binding **32** about a vertical axis. The action of tip **88R** against beveled notch **59R** causes bail **35** to move rearward, allowing cleat **31** to rotate to a position where it contacts cleat ejector ramp **69**, forcing cleat **31** upward and free from binding **32**. Other types of recessed cleats and bindings exist and could easily be substituted for the bindings shown, as they are of similar size and shape. Bindings **32** extend far enough above the top surface of shoe supporting surface **15** to allow cleat engagement, rotation and release without shoe sole **28** making contact with shoe supporting surface **15**.

One or both bases **34** rotatably connect the ends of links **42**, to form a parallelogram type linkage. This forces links **42** to undergo simultaneous rotation when pivoting on axles **44**. This results in both bindings **32** either extending out of cutout **30** of pedal body **14**, or retracting into it simultaneously, when links **42** pivot counter-clockwise or clockwise, respectively, on axles **44**, as viewed in figs 3A, and 3B respectively. The retracted position of each binding **32** is determined by stop ledge **80**, which contacts the bottom edge of bail **35**, as shown in figure 3B, preventing any further retraction of bindings **32** into cutout **30** of pedal body **14**. When fully retracted, the top exposed surfaces of bindings **32** are sufficiently flush, or below the top surface of shoe supporting surface **15** to assure that full and secure contact of sole **28** is made with shoe supporting surface **15**, without contact of recessed cleat **31**, on any part of the pedal (fig. 4B).

Extension of bindings **32** from the retracted position of figures 1B, 3B, and 4B are performed by placing thumb or forefinger **98** into cutout **36** on bail **35**, and an opposing finger or thumb **99** on the top forward edge of pedal body **14**, as shown in figure 3B, then squeezing finger and thumb together while simultaneously pulling upwards to extend bindings **32** to their extended position, as shown in figure 3A. This is a motion that can be performed while astride the bicycle, if desired, without the rider needing to look down at the pedal, at these features are large and easy to recognize by feel, and the motion is simple. In the fully retracted position of figure 3B, angle, $\phi$ , formed between a line through both link **42** rotation pivot axes at axles **44** and a line through one link **42** rotation pivot axis at axle **44** and a pivot axis at either pin **38F** or **38R** on the same link **42** is no less than 10 degrees. This prevents the parallelogram linkage from collapsing into an unstable state where all pivot axes at axles **44**, **38F**, and **38R** lie in a single plane, which could prevent the extension of both bindings **32** by the aforementioned action of squeezing thumb **98** and finger **99** against bail **35** and pedal body **14**, respectively.

Force for retraction motion of bindings **32** is provided by retraction springs **45**, located coaxially on axles **44**. One end of spring **45** bears against link **42**, and the other against central tube **76**, thus urging link **42** to rotate towards the retracted binding position. Bindings **32** are held in the extended position of figs. 1A, 2 and 3A by protrusions **47** and **49** on both clips **46** and **50**, which rotate inward towards bindings **32** under the action of clip springs **52**, to capture and restrain links **42** against rotation, as shown in figs 2 and 5A.

When extending bindings **32**, from the retracted position, as shown in figs. 1B and 4B, the front edge of link **42** slides against bevel **51**, serving to pivot clips **46** and **50** laterally outward away from

bindings **32**, as shown in fig. 6B. Bevel **51** is best viewed in figure 7. In the outwardly pivoted position of clips **46** and **50**, protrusions **47** extend inward toward bindings **32** slightly more than protrusions **49**, providing a positive motion stop for links **42** upon full extension of bindings **32**. Lock tab **41** is beveled on its underside to avoid interference with outwardly rotated ends **53** of clips **46** and **50**, as bindings **32** approach their fully extended position. Once motion of links **42** are stopped in the binding extended position (fig. 6B), clips **46** and **50** pivot about pins **48** inward toward the binding under the actions of clip springs **52** to firmly lock links **42** into the binding extended position shown in figures 1A, 2, 3A, 4A and 6A. With the cleats **31** engaged, the rider may, in addition to the usual downward pushing force, also push forward and/or pull rearward at top and bottom parts of the pedal stroke, respectively, and this force is transmitted to the pedal body by clips **46** and **50** through pins **48** to transfer additional motive energy to the bicycle. Furthermore, these forward and rearward pedaling forces are transferred into pedal body **14** by all 4 clips (**46** and **50**) and pins **48**, even though only one binding **32** is engaged. This reduces stress and deflection on these and other components.

To retract bindings **32** for unbound operation, the cyclist pushes inward with forefinger or middle finger **98** on release plates **58A** and/or **58B**, near or on the hinge joint of pin **62** and hinge loops **64A** and **64B** connecting them together (fig. 6B). These plates are large and easy to find by feel, without the rider needing to look down to find them. The motion is, like the aforementioned binding extension operation, easily accomplished while astride the bicycle, without the need to look down at the pedal. In the usual case where the cyclist's shoe cleat **31** is not engaged with binding **32**, the toggle-like spreading action of release plates **58A** and **58B**, as they are depressed, serve to push both hinge loops **56** on spring levers **54** apart from each other, causing clips **46** to pivot away from the binding, thereby releasing both links **42** which are held by clips **46**. Simultaneously, each end **55** of clip **46** pushes against end **57** of clip **50** during this pivoting motion, causing clips **50** to pivot away from both links **42** which they are engaged with, as shown in figure 6B. Both bindings **32** are then free to retract into cutout **30** of pedal body **14**, under the actions of retraction springs **45**. The stiffness of spring lever **54** is made sufficiently higher than the stiffness of clip springs **52** to assure sufficient rotation of clips **46** and **50** under these conditions. Should any unbalanced forces be present between bindings **32** and their associated clips and spring levers, such as from presence of dirt, or a forward or rearward force component applied to release plates **58A** and/or **58B**, stop buttons **74** provide a centering force to maintain symmetric and equal pivoting action of all clips **46** and **50** at their maximum outwardly pivoted angle, as shown in figure 6B. This ensures that both bindings **32** are released for retraction simultaneously. Release of links **42**, and thus retraction of bindings **32**, will occur just before release plates **58A** and **58B** reach their fully spread position, however provision for these release plates to reach and extend past their fully spread position is provided for an alternate mode of operation described in the next paragraph below. If this overextension occurs, as shown in fig. 6A where angle **θ'** is less than 180 degrees, under either mode of operation, pushrod **68**, slidably located in bore **71** of pedal body **14** provides for return of release plates **58A** and **58B** to a less than fully spread position by moving laterally outward to contact release plate **58A**, as indicated in figure 6B by angle **θ** exceeding 180 degrees. This occurs when the front edge of link **42** slides against conical end **70** of pushrod **68**, pushing it outwards when almost fully pivoted to the position for full binding **32** retraction shown in figures 4B, and 5C. Once release plates **58A** and **58B** reach a less than fully spread position, clip springs **52** move them back to their normal resting position through clips **46** and **50**, and spring lever **54**. The bulged center section of link **42** occludes a small part of conical end **70** throughout the range of motion of link **42**, thus allowing only the majority of conical end **70** to extend into cutout **30**. The cylindrical section of pushrod **68** is kept within bore **71** to avoid contact with the edge of links **42**, which would prevent

their rotation. Release plate **58A** prevents pushrod **68** from falling out of bore **71**.

Though the motion of bindings **32** relative to shoe supporting surfaces **15** is arcuate, it is the height of the top surfaces of each binding **32** relative to the height of the corresponding shoe supporting surface **15** which determines whether the pedal can be used in either a clipless binding mode, with a cycling shoe **27** having a sole **28** recessed cleat **31** contacting and engaging only a clipless binding **32**, or in an unbound mode where a cycling shoe **27**, or other shoe contacts only a shoe supporting surface and is otherwise unattached to the pedal. This relative height can be generally defined as the difference in height of a plane parallel to the rotation axis of pedal spindle and tangent to shoe supporting surface **15**, at the point of shoe sole **28** contact, and the height of a plane similarly parallel to pedal spindle **12** rotation axis and tangent to the uppermost facing surfaces of a binding **32** at a similar point of shoe **27** or cleat **31** contact. Thusly, pedal body **14**, pins **38F** and **38R**, links **42**, pins **44**, springs **45**, clips **46** and **50**, pins **48**, springs **54** , release plates **58A** and **58B**, pins **60** and **62**, comprise the primary parts of a rider actuated linkage **43** (fig.3A) that stably supports and connects bindings **32** to shoe supporting surfaces **15** in a relative variable height configuration.

Figure 3C and 6A show operation of a "pre-retract" mode of operation whereby the pedal can be set in advance to automatically retract bindings **32** into cutout **30** immediately upon release of cleat **31** from binding **32**. When cleat **31** is engaged with binding **32**, upper lockspring **40** is deflected downward, placing lock tabs **41** into the space between tabs **53** and cutout **30**. This blocks the pivoting action of upper clips **46** and **50** thus preventing retraction of bindings **32**. The cyclist still depresses release plates **58A** and/or **58B** in the manner previously described, and this action will cause spring levers **54** to bend into an arcuate shape, as shown in figure 6A. When release plates **58A** and **58B** are fully depressed, they extend through their maximally spread position until hinge loops **64A** and **64B** contact pedal body **14** at the base of pocket **72**, shown as **θ'** in fig. 6A. They are held in this overextended position, which is slightly but sufficiently stable, under the force of spring levers **54** until the cyclist disengages cleat **31** from binding **32**. Cleat **31** disengagement allows lock spring **40** to unbend, moving lock spring ends **41** upward and out of the space between tabs **53** and cutout **30**. This frees clips **46** and **50** to pivot fully outward away from bindings **32**, under the action of spring levers **54**, as shown in figure 6B. Bindings **32** are then free to retract into cutout **30** under the action of retraction springs **45**, as described previously. Similarly as before, when bindings **32** approach their fully retracted position, outer front edge of link **42** slides against conical end **70** of pushrod **68**, thus urging pushrod **70** outward, against release plate **58A**. This outward movement of pushrod **68** is sufficient to articulate release plates **58A** and **58B** out of their overextended position whereby the force of spring levers **54** return release plates to their normal resting position.

In an alternate embodiment, shown in figure 8, only one binding **32**, is present. Otherwise, the construction and operation of the pedal is similar to the preferred embodiment having two bindings. This allows easy and simple convertibility to the preferred option by the simple addition of another binding **32**.

A further alternate embodiment of the convertible pedal is shown in figures 11 through 14. A pedal for the left side of the bicycle is shown in all figures. Figure 11A provides a general view of most parts and features. A pedal spindle **112**, preferably formed of high strength steel or titanium alloy, features threads **111** for attachment to a bicycle crank arm (not shown), and wrench flats **113** for tightening to crank arm. Pedal body **114** is preferably formed of aluminum alloy, or other lightweight metal or high strength plastic. All subsequently described parts, unless otherwise noted, are preferably formed of high strength metal such as aluminum, steel, or titanium alloys. Body **114** features central bore **186** (fig. 14), two left side arms **117L**, two right side arms **117R**, and four bail pivot pin bores **137"**. Central bore **186** is machined with threads and multiple steps (not labeled).

Spindle **112** is rotatably connected to central bore **186** by sealed roller bearing **116**, and ball bearing assembly **118** (fig. 14). Sealed roller bearing **116** is a needle type roller bearing that is fixedly mounted in central bore **186** and rotates on journal **119**. Roller bearing **116** features integral shaft seals (not labeled) on both sides of the cylindrical rolling elements. Ball bearing assembly **118** comprises two angular contact outer ball races **120A** and **120B**, that are filled with balls **121**, which ride in groove **122** of pedal spindle **112**. Retainer cap **124** features hex wrench socket **125**, and threads into central bore **186**, to tighten against and fixedly retain outer ball races **120A** and **120B**. Retainer cap **124** features pivot journal **150** (figs. 11A, 11B, 12A, 12B, 14), which is concentric with central bore **186**. Pivot tube **152** (fig. 14) is fixedly mounted in central bore **186** and features pivot journal **154** which is also concentric with central bore **186**. A small radial clearance is present between pivot tube **152** and spindle **112** such that no rubbing contact occurs.

Two bindings **132** (fig. 12D) are present, one on the upward, shoe facing side of the pedal, and one on the downward, ground facing side of the pedal. Each binding **132** is an assembly comprising base **134**, bail **135**, bail pivot pin **138**, left and right bail springs **139L** (fig. 13A) and **139R** respectively, block **140**, and adjustment screw **141**. Base **134** is fixedly mounted to body **114** with screws **195**. Slot recess **130** (fig.11A) locates base **134** onto body **114**. Bail pivot pins **138** are fixedly mounted in bail pivot pin bores **137"** of left and right side arms **117L** and **117R** and rotatably support bails **135** on bail pivot pin bores **137'** of bail pivot tabs **136L** and **136R**. Left and right bail springs **139L** and **139R** are also rotatably supported on bail pivot pins **138**. Each bail **135** is urged forwards against base **134** by bail springs **136L** and **136R**. Urging force of each pair of bail springs **136L** and **136R** is adjustable by adjustment screw **141**, threaded into block **140**, and bearing against body **114**. Both base **134** and bail **135** feature cleat engaging notches **192**. Base **134** features cleat engagement guides **190**, and left and right cleat ejector ramps **191** (fig. 11A).

Left front rail connector plate **144L** features left pivot bore **145L** (figs. 12A, 12B, 13B, 14), limit slot **160** (figs. 12A, 12B, 12C), spring end slot **164** (figs. 11A, 12A, 12B), spring end bore **166** (fig.12C), retraction lock pin bore **178** (fig. 13A), left semicircular surface **175L**, two rail mount tabs **179**, each tab featuring two threaded holes **181**. Left rear rail connector plate **146L** features left pivot bore **147L** (figs. 13B, 14), spring end bore **165** (fig.12C), limit slot **162** (figs. 12A, 12B, 12C), extension lock pin bore **167L** (figs. 12B, 12C, 13A, 13B), retraction lock pin bore **177** (figs. 13A, 13B), four threaded holes **185** (figs. 11B, 12B), two rail mount tabs **179**, each tab featuring two threaded holes **181** (fig. 11A). Right front rail connector plate **144R** features pivot bore **145R** (figs. 13B, 14), right semicircular surface **175R** (fig. 13A), two rail mount tabs **179**, each tab featuring two threaded holes **181**. Right rear rail connector plate **146R** features right pivot bore **147R**, extension lock pin bore **167R**, two threaded holes **185**, and two rail mount tabs **179**, each tab featuring two threaded holes **181** (fig. 13A). Pivot journal **150** rotatably supports left front and rear rail connector plates **144L** and **146L** on their pivot bores **145L** and **147L** respectively. Similarly, pivot journal **154** rotatably supports right front and rear rail connector plates **144R** and **146R** on their pivot bores **145R**, and **147R**, respectively. Two front rails **142** are fixedly attached to rail mount tabs **179** of left and right front rail connector plates, **144L** and **144R** with screws **187**, to form a front rail cage assembly **148** (figs. 11B, 12B) which pivots as a unit on journals **150** and **154**. Similarly, two rear rails **143** are fixedly attached to rail mount tabs **179** of left and right rear rail connector plates, **146L** and **146R** with screws **187**, to form a rear rail cage assembly **149** (figs. 11B, 12B) which also pivots as a unit on journals **150** and **154**. Pedal body **114** features limit pin bore **159** (figs. 13A, 13B). Limit pin **158** is fixedly mounted in limit pin bore **159** and protrudes through both limit slot **160** of left front rail connector plate **144L** and limit slot **162** of left rear rail connector plate **146L**. Front and rear shoe supporting surface sections **115F, 115R**, optionally textured as shown here, are formed in the upward, shoe facing edges of both front rails **142**, and rear rails **143**, respectively, to provide

good shoe sole **28** traction (fig. 12B) when operating in unbound mode. Each pair of front and rear shoe supporting surface sections **115F** and **115R**, respectively, on each side of the pedal form a shoe supporting surface **115** (fig. 12B), as an assembly, since neither section can support a shoe by itself, due to the freely rotatable body **114**. Rail extension spring **156** is rotatably mounted on pivot journal **150**, and features ends **157A** and **157B** (fig. 11A). End **157A** is fixedly mounted in spring end bore **165**, and end **157B** protrudes through spring end slot **164**, and is fixedly mounted in spring end bore **166**. Rail extension spring **156** urges front rail cage assembly **148** to pivot on journals **150** and **154** clockwise relative to rear rail cage assembly **149**, as viewed in figs. 12A, 12B, 13A, and 13B.

Left extension lock pin housing **172L** (figs. 11A, 13A, 13B) is fixedly mounted to left rear rail connector plate **146L** with housing screws **188** in threaded holes **185**. Similarly right extension lock pin housing **172R** is fixedly mounted to right rear rail connector plate **146R** with housing screws **188** in threaded holes **185**. Housings **172L** and **172R** feature housing lock pin bores **174**, which are located coaxially with left and right extension lock pin bores **167L** and **167R**, respectively. Left and right extension lock pins **168L** and **168R** are slidably mounted in housing lock pin bores **174**, and are urged transversely outwards from the vertical midplane of the pedal by the action of springs **170**. Extension lock pins **168L** and **168R** feature shoulders **169** which limit their outward motion by contact with left and right rear rail connector plates **146L** and **146R**, respectively. Similarly, retraction lock pin housing **176** is fixedly mounted to left rear rail connector plate **146L** with housing screws **188**, in threaded holes **185**, and features a housing lock pin bore **174** located coaxially with retration lock pin bore **177**. Retraction lock pin **182** is slidably mounted in housing lock pin bore **174** and is urged outward by spring **184** to pass through retraction lock pin bore **177**. Shoulder **183** limits outward motion of retraction lock pin **182** by contact with left rear rail connector plate **146L**.

In operation, for clipless binding mode, as depicted in figs. 11A, 12A, 12D, 13A, and 14, binding **132** engages and disengages cleat **31** in the same manner as binding **32** in the preferred embodiment, and the description will not be repeated here. In clipless binding operation, front rail cage assembly **148** and rear rail cage assembly **149** are rotated about an axis through the center of pivot journals **150** and **154** to retract shoe supporting surface sections **115F** and **115R** sufficiently toward the horizontal midplane of the pedal to allow cleat **31** to engage either of the two bindings **132** without contact of sole **28** against the corresponding shoe supporting surface sections **115F** and **115R** (fig. 12A) on the same side of the pedal. Front rail cage assembly **148** and rear rail cage assembly **149** are held in this retracted position against the force of rail extension spring **156** by retraction lock pin **182** which extends though lock pin bores **177** and **178**, thus preventing front rail and rear rail cages from pivoting about the journal axis with respect to each other. Front and rear rail cages **148** and **149**, respectively, are simultaneously aligned rotationally with respect to body **114** by contact of limit pin **158** against semicircular end **160'** of front rail limit slot **160** and semicircular end **162'** of rear rail limit slot **162**, respectively. No shoe forces are applied to front rails **142** or rear rails **143**, thus only one retraction lock pin **182** is necessary. Cleat **31** can be engaged and disengaged freely from either binding **132** for clipless binding operation without contact of sole **28** on front or rear shoe supporting surfaces **115F** and **115R**, respectively, or any other part of front or rear rail cage assemblies **148** and **149**, respectively. Left and right extension lock pins **168L** and **168R** are held fully retracted inside extension lock pin housings **172L** and **172R**, by left and right front rail connector plates **144L** and **144R**, respectively (fig. 13B).

To set the pedal for unbound operation, as is depicted in figs. 11B, 12B, 12C, and 13B, whereby sole **28** applies full pressure to either shoe supporting surface **115**, without contact of recessed cleat **31** on any part of either binding **132** or any other part of the pedal, retraction lock pin **182** is depressed with thumb or finger (not shown) until it exits retraction lock pin bore **178**. Rail extension spring **156** then urges front rail cage assembly **148** to pivot on journals **150** and **154** clockwise with

respect to rear rail cage assembly **149**, as viewed in fig 12B. This scissors-like action moves both front shoe supporting surface sections **115F**, and rear shoe supporting surface sections **115R** away from the horizontal midplane of the pedal, extending above bindings **132** on each side of the pedal, and effectively increasing the height of shoe supporting surfaces **115** relative to the height of bindings **132**. Once the full outward extension of front rail cage assembly **148** and rear rail cage assembly **149** are reached, they are held in this extended position by left and right extension lock pins **168L** and **168R**, respectively, which extend outward from the vertical midplane of the pedal, through extension lock pin bores **167L** and **167R**, respectively, and through the cylindrical surfaces defined by left and right semicircular surfaces **175L** and **175R**, respectively, thus preventing front rail cage assembly **148** from pivoting counterclockwise with respect to rear rail cage assembly **149** on pivot journals **150** and **154**. Front and rear rail cage assemblies **148** and **149**, respectively, are simultaneously aligned rotationally with respect to body **114** by contact of limit pin **158** against semicircular end **160"** of front rail limit slot **160**, and semicircular end **162"** of rear rail limit slot **162**. In this position shoe forces applied to front and rear shoe supporting surface sections **115F** and **115R**, respectively, tend to urge, with high force, front rail cage assembly **148** to pivot counterclockwise relative to rear rail cage rail assembly **149**, towards the retracted rail position. High shearing forces are generated on extension lock pins **168L** and **168R**, between extension lock pin bores **167L** and **167R**, and semicircular surfaces **175L** and **175R** respectively, and thus two lock pins are used, one on each side of the pedal. This also eliminates twisting forces in front and rear rail cage assemblies **148** and **149** that would be generated if only one extension lock pin **168L** or **168R** was used. In this configuration, retraction lock pin **182** is held fully retracted inside retraction lock pin housing **176** by left front rail connector plate **144L** (fig.13B).

To set the pedal for clipless binding operation, from the unbound, rail cage extended position, front rail cage assembly **148** and rear rail cage assembly **149** are retracted toward the horizontal midplane of the pedal by placing a thumb or finger **98** on front shoe supporting surface section **115F** and an opposing finger or thumb **99** the adjacent rear shoe supporting surface section **115R**, and squeezing them together, while simultaneously, with the other hand, depressing both extension lock pins **168L** and **168R** towards each other, into their respective housings **172L** and **172R**, with the tip of a thumb or finger **98** (fig. 12B) and the tip of an opposing finger or thumb **99** (not shown), respectively. Once left and right extension lock pins **168L** and **168R** are fully depressed into left and right extension lock pin bores **167L** and **167R**, respectively, front rail cage assembly **148** can be pivoted counterclockwise with respect to rear rail cage assembly **149** until the fully retracted rail position is reached and locked, as described earlier.

Thusly, body **114**, bearings **116** and **118**, pivot journals **150** and **154**, extension lock pins **168L**, **168R**, retraction lock pin **182**, front rail cage assembly **148**, and rear rail cage assembly **149** comprise the primary parts of a rider actuated linkage **110** (fig. 11A) rotatably connecting both bindings **132** and shoe supporting surfaces **115** to pedal spindle **112** in a variable relative height configuration, sufficiently variable to allow the pedal to be used either as a clipless pedal on both sides of the pedal or as a unbound type pedal on both sides of the pedal, where the shoe is not attached to the pedal, and recessed cleat **31** does not contact any part of the pedal.

## CONCLUSIONS, RAMIFICATIONS, AND SCOPE

In conclusion, the invention provides a bicycle pedal that can be operated in either clipless binding mode on both sides of the pedal simultaneously or in unbound mode on both sides of the pedal simultaneously. It eliminates the need to carry separate shoe supporting surfaces that can be attached to a clipless binding pedal. The invention is an improvement over existing dual mode

pedals, that have one side operating in unbound mode and the other side operating in clipless binding mode, by eliminating the necessity to spin the pedal one half turn, after determining which side is upwardly facing the shoe sole, in order to choose between clipless binding mode and unbound mode operation. This results in safer and more enjoyable riding, and provides a time advantage in some types of racing.

The description above is detailed and specific, showing only several embodiments out of many possible ones which provide the same novel functionality. As such, the invention is not limited to the description in scope. For example, new materials or fabrication methods may be substituted for the suggested ones in the description, and parts may be changed in size and shape to reduce weight, and costs, to increase strength and durability, or to improve performance, especially in adverse conditions such as the presence of mud or dirt. For instance, in the preferred embodiment, shoe supporting surfaces **15** could be placed slightly higher (further apart from each other) and links **42** made slightly longer to retract bindings **32** further into pedal body **14**. This might provide better shoe sole grip for worn down shoe soles. It could allow the use of certain non-sole recessed cleat and binding systems by allowing the cleat to protrude into cutout **30**. There are other possible mechanism configurations which provide similar functionality. As an example, it is possible to modify the alternate embodiment by affixing bases **134** to rear rail connector plates **146L** and **146R**, and affixing bail pivot pins **138** to front rail side plates **144L** and **144R**, in order to provide height variability in both the binding and the shoe supporting surfaces. This slightly reduces the total height of the pedal when operating in unbound mode. It would also be possible, and obvious to combine the main features of both the preferred embodiment with those of the last alternative embodiment, including the automatic conversion to unbound mode upon cleat release from the binding. There are other existing bindings possible which can be substituted, some of which are simple enough to be formed contiguous with a connecting linkage. Other possible bindings exist which can be substituted that have no moving parts. Other bindings which engage a non-sole recessed cleat may also be used to advantage, as the cleat could protrude slightly into cutout **30**. The shoe supporting surfaces **15** of the preferred embodiment may be shaped differently than shown, such as flat, rather than curved. They may have less surface area shown, to provide extra clearance for muddy conditions. The shoe supporting surfaces of the preferred embodiment may consist of traditional cages, similar to the last alternative embodiment, rather than broad surfaces, though this might limit its compatibility to certain types of shoe sole designs. The need to seal, or otherwise protect the moving mechanisms against dirt and water is obvious and the addition of features not described here can be anticipated, such as shaft seals for exposed rotating parts, flexible boots for exposed sliding parts, gaskets, surface hardening treatments, the addition of rolling elements to replace sliding surfaces or elements, dry-film surface lubrication treatments, surface corrosion protection treatments, surface texturing treatments, or features to provide better shoe grip, etc. The second alternative embodiment described here, having only one binding, but retaining some of the parts necessary for operation with two bindings can obviously be simplified for cost savings, at the expense of being easily convertible to the preferred embodiment, by the simple addition of another binding. Similarly, the last alternative embodiment can be reconfigured to provide for lighter weight, lower cost, and to provide other improvements.

Thus, the scope of the invention should be determined by the appended claims and their legal equivalents, rather than by the examples given.